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Short Communication

Effects of the Dietary Inclusion of Lentil Byproducts on the Performance, Internal Organs Weight and Carcass Yield of Growing Quails

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ABSTRACT

This study was conducted to investigate the effects of different levels of lentil byproducts on the growth performance, relative weight of internal organ and carcass traits of growing quails. Day-old quails (240; *Coturnix coturnix japonica)* were randomly divided into 4 treatments, each with 4 replicates: control, 10%, 15% and 20% lentil byproducts—fed to the quails between 1 to 35 days of age. The mash experimental diets were isocaloric and isonitrogenous. No significant effects of the lentil byproduct inclusion level were observed on the mean total feed consumption, feed conversion ratio and body weight. Similarly, the relative weight of internal organs and carcass yield were not significantly affected by lentil byproducts' inclusion levels. The results indicate that lentil byproducts might be included in the diet of growing quails up to a level of 15% with no negative effects.

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SE conceived and designed the experiments. MÇ performed the experiments and analyzed the data. AA wrote the paper.

Key words
Lentil byproduct, Quail, Performance, Internal organs weight.

Cereal seeds are used as human food and feedstuffs, as well as bio-fuels and bio-industrial products. Furthermore, the price of soybean and corn has doubled over the past seven years, forcing the poultry industry to consider the inclusion of alternative feeds into the diet (Woyengo *et al*., 2014). Therefore, it became necessary to investigate new alternative feed and food sources. Before being made available for human consumption, leguminous seeds are processed, generating various processing byproducts, such as pea byproducts, lentil byproducts and sunflower meal. These byproducts are used as cheap feed sources in animal diets. The peel of red lentils is removed and cleaned during processing in factories and used as an edible product. After this process, colour-sorting machines are used to separate the harvested feedstuffs depending on their colour. The goal here is to separate items that are discoloured, insufficiently ripe, or keeping the hull after de-hulling (Low *et al*., 2001). During this sorting process, a new byproduct is obtained, henceforth named the 'sorting byproduct'. This sorting byproduct comprises 2–4% of the total processed lentils. It is cleaner and has a higher quality than other lentil byproducts, although it is not suitable for human consumption. Lentils (*Lens culinaris* L.) do not require watered land areas, and they are produced in relatively high amounts in Canada, India and Turkey. Although they are primarily used for human consumption, they are capable of being an excellent protein-rich (22–29%) feedstuff for domestic livestock. However, they contain certain anti-nutritional constituents, such as tannins, phytic acid and trypsin inhibitors which can limit their carbohydrate and protein utilisation (Aguilera *et al*. 2010). These anti-nutritional factors may cause adverse effects on livestock. To date, the effects of the dietary inclusion of lentil byproducts on the growth performance, carcass characteristics, feed consumption and feed conversion of quails remain unknown. Therefore, our aim of this study was to investigate the levels of lentil byproducts that can be included in the diets of quails without causing any negative effects. The study was aimed at the effects of different levels of lentil byproducts on the growth performance, relative weight of internal organ and carcass traits of growing quails.

Materials and methods

Day-old quails (240; *Coturnix* coturnix *japonica)* were randomly divided into 4 treatments, each with 4 replicate *viz.,* control, 10%, 15% and 20% lentil byproducts, fed to the quails between 1 to 35 days of age. Water and feed

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were supplied *ad libitum*. A 24 h/day light was provided. At the end of the experimental period, 24 quails (*i.e.* 12 males, 12 females) of similar bodyweight were selected from treatment groups, weighed and slaughtered in order to calculate the internal organs weight and carcass rate. The lentil byproducts and diets were analysed for crude protein, starch, dry matter, sucrose, crude ash and ether extract and according to method of VDLUFA (Naumann and Bassler, 1993)

The nutritional compositions of the lentil byproducts are presented in Table I. The nutritional composition and ingredients of the experimental diets are presented in Supplementary Table SI. Data were analysed using the general linear model with the SPSS 12.00 statistical software (SPSS Ltd., Woking, Surrey, UK). The significant differences among treatments were separated by Duncan's Multiple Range test at $\alpha = 0.05$ levels. The experiment protocol was approved by the Institutional Animal Care and Use Committee (Permission No. 2014/11. 77.637.437).

Results

The effects of the dietary inclusion of lentil byproducts on the feed consumption, feed conversion ratio (FCR) and body weight of quails up to the 35th days of age are presented in Table I. The inclusion of up to 20% lentil byproducts in quail diets had no adverse effects on the body weight, feed consumption and FCR of the quails, both from 1 to 21 and from 1 to 35 days of age ($P > 0.05$).

The relative weights of the carcass and of the pancreas, proventriculus, liver, gizzard, and small intestine relative weights, as well as the length of the small intestine, are presented in Table II. The percentages of the liver, gizzard, proventriculus, carcass, small intestine and small intestine length were not significantly affected by the dietary inclusion of lentil byproducts ($P > 0.05$). On the other hand, the dietary inclusion of lentil byproducts affected the weight and rate of the pancreas, where the relative weights of the pancreas was significantly increased with the inclusion of 20% lentil byproducts compared with the 10%, 15% and control levels ($P < 0.05$). Mortality was not affected by the dietary inclusion of lentil byproducts. The mortality rates were 1.67%, 0 %, 0% and 1.67% for control and the 10%, 15% and 20% dietary treatment groups, respectively.

Table I.- Effect of lentil byproduct on body weight (g), feed consumption (g) and the feed conversion ratio (g feed/g gain) of the quail.

Treatments/	Body weight (g)		Feed consumption (g)		FCR (g feed/g gain)	
Age (days)	21	35	0-21	0-35	0-21	0-35
Control	112.69	164.61	254.68	544.86	2.26	3.31
10 % Lentil byproduct	114.43	164.02	260.90	544.54	2.28	3.32
15 % Lentil byproduct	111.67	163.01	256.84	541.19	2.30	3.32
20 % Lentil byproduct	115.40	163.56	267.73	547.93	2.32	3.35
SEM pooled	1.63	2.54	6.00	12.65	0.063	0.060
Probability, (P<0.05)	0.3606	0.9692	0.8163	0.9876	0.9758	0.9741

Chemical analysis of lentil by product: dry matter - 88.20%, crude protein - 25.42%, ether extract - 2.19%, crude fiber - 3.48%, crude ash - 6.11%, starch - 42.9%, sucrose - 3.12%, condensed tannin (g/kg, dry matter)- 4.41, metabolisable energy (MJ/kg) - 12.27.

Table II.- Effect of lentil by product on relative weight (% body weight) of some internal organs of quails at 35 day of age.

Parameter/ Treatments	Control	10% Lentil by product	15% Lentil by product	20% Lentil by product	SEM pooled	Probability (P<0,05)
Carcass yield (%)	70.84	71.20	70.68	70.61	0.382	0.7067
Pancreas (%)	0.211[b]	0.215[b]	0.218[b]	0.239[a]	0.008	0.0507
Liver (%)	1.97	1.85	1.84	1.86	0.087	0.2878
Proventriculus (%)	0.477	0.466	0.486	0.494	0.026	0.8547
Gizzard (%)	2.171	2.114	2.333	2.251	0.094	0.3897
Small intestine (%)	1.78	1.70	1.81	1.69	0.066	0.4887
Small intestine length (cm)	49.45	49.86	49.28	50.35	1.008	0.6903

a and b, means within the same row with no common superscript differ significantly (P<0.05).

Discussion

In general, the dietary inclusion of lentil byproducts up to 20% did not affect the body weight of quails at 21 and 35 days. Similar finding were reported by Ayasan *et al*. (2018) who demonstrated that the inclusion of lentils in broilers' diet did not affect their body weight, and by Sögüt *et al*. (2018) who noted that the dietary inclusion of lentils at a 20% level did not affect the body weight of turkeys. Contrary to our results, a negative effect on the body weight of quails was found with the dietary inclusion of more than 20% lentil byproducts (Kanat, 1992). Furthermore, Kanat and Camcı (1993) noted that the inclusion of 20% lentils in diets had a negative effect on the performance of laying hens.

In the present study, the feed consumption and FCR were also not affected by the dietary inclusion of lentil byproducts. This is in agree with the results reported by Ciurescu *et al*. (2017) who reported that the inclusion of lentil byproducts in the diet of broilers did not affect the feed consumption or FCR. Besides, the results of our experiment are similar to those obtained by Çabuk *et al*. (2014) and Ayasan *et al*. (2018). Furthermore, Yalcın *et al*. (1991) reported that the inclusion of lentil byproducts in diets had no adverse effects on the feed consumption and FCR in poultry. In contrast with our results, Sögüt *et al*. (2018) showed that the inclusion of more than 20% lentil byproducts in the diet of turkeys worsened the FCR.

With regard to the relative weight of the carcass and digestive organs, similar findings were reported by Sögüt *et al*. (2018) who found that, in turkeys, the carcass traits and digestive organs' weight were not affected by the dietary inclusion of lentil byproducts. Our findings were also consistent with those of Ciurescu *et al*. (2017) who reported that the inclusion of lentils in the diet of broilers did not affect the weights of the gizzard, pancreas, liver, heart, small intestine and the length of the small intestine. However, our results showed that the relative weight of the pancreas becomes significantly lower ($P < 0.05$) with the inclusion of 20% lentil byproducts. The results found by Viveros *et al*. (2001) and Arija *et al*. (2006) are partially consistent with the present results, as they demonstrated an increase in the relative weight of the liver of birds fed with other legumes, such as chickpeas and kidney beans. The increase in the relative weight of the pancreas, upon the inclusion of 20% lentil byproducts, could have resulted from the presence of anti-nutritive factors such as trypsin inhibitors and tannins.

Conclusion

The results of the our experiment showed that the dietary inclusion of lentil byproducts up to a level of 15% had no adverse effects on the body weight, feed consumption, FCR and relative weight of digestive organs in quails. However, we concluded that lentil byproducts can be used in the diet of growing quails up to a level of 15% and that this amount can reduce the feeding cost by 5%. Nevertheless, lentil byproducts need to be studied with other poultry species in detail.

Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20190107180141

Statement of conflict of interest

The authors have declared no conflict of interests.

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